

# Higher Spin Holography and dS/CFT

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# Holography

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- $d+1$  quantum gravity  $\longleftrightarrow$   $d$  QFT

## Many open mysteries

- How does the bulk spacetime emerge?
- How general is holography?
  - ▶ Does it apply in flat space? Cosmology?

A solveable model might help answer these questions.  
We can try very hard to solve string theory, or seek simplified toy examples.

# A Toy Model

## Higher Spin Gravity

3d  
Free fields



4d  
gravity in AdS  
+ gauge fields  
with spins = 3,4,5...

Vasiliev

- Quantum gravity from free fields: Exactly solvable
- Toy model for string theory in the stringy limit
- **However:** (1) Vasiliev theory is complicated, (2) no Einstein-gravity-like limit

# 3 Examples of Higher Spin Holography

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## 2. Holographic “Minimal models”

- 3d Vasiliev gravity = 2d exactly solvable minimal model CFT

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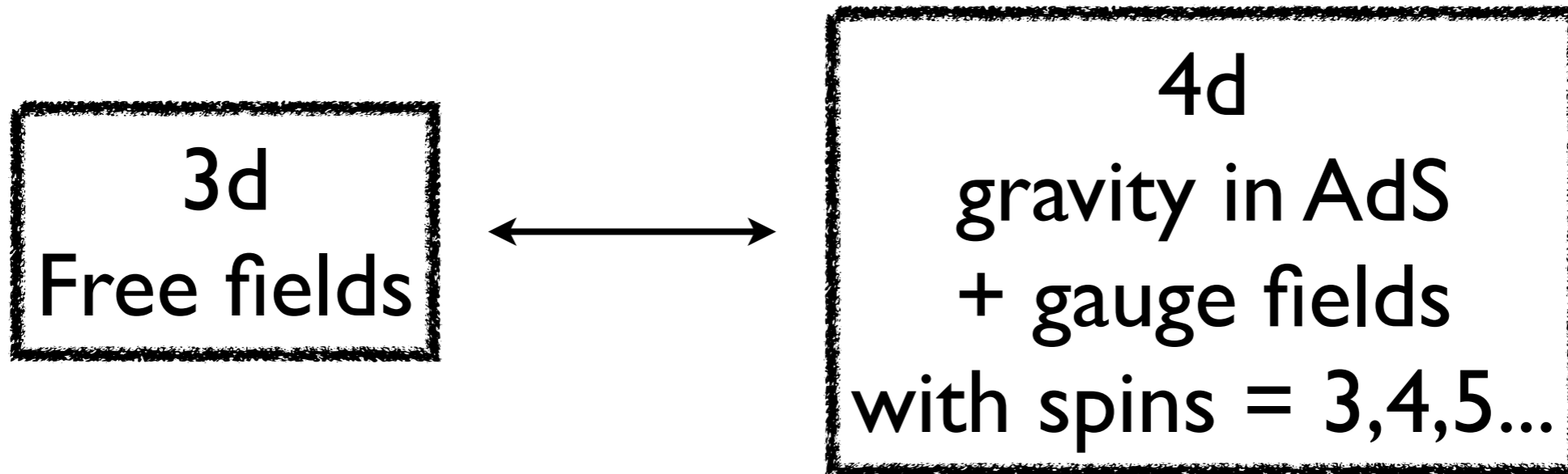
## 3. Higher Spin dS/CFT Correspondence

- 4d Vasiliev gravity in de Sitter space  
= Free 3d CFT

Anninos, TH to appear

# Klebanov-Polyakov Correspondence

Klebanov, Polyakov '02

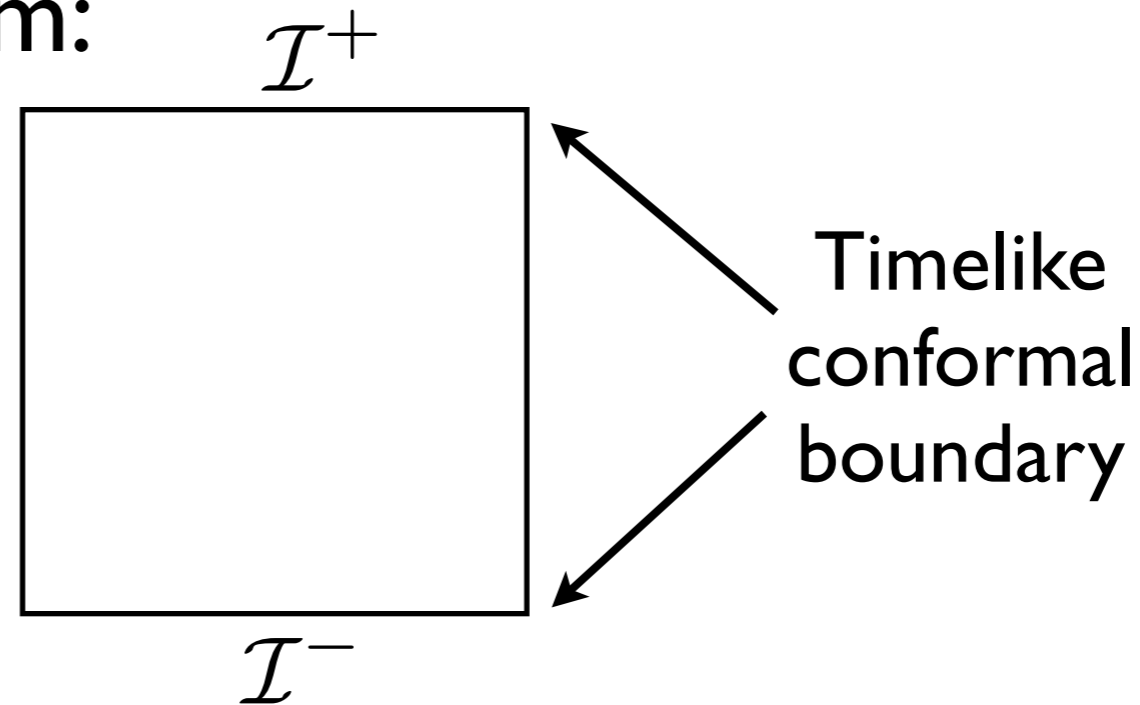


$$J^{(s)} = \phi \partial_{\mu_1} \cdots \partial_{\mu_s} \phi \longleftrightarrow A_{\mu_1 \mu_2 \cdots \mu_s}^{(s)}$$

$$\nabla \cdot J = 0$$



- The dS/CFT correspondence, if it exists, is very different from AdS/CFT.
- Penrose diagram:



- A general dS/CFT dictionary has been proposed, but an explicit example is lacking.  
Witten '01; Strominger '01; Maldacena '02

# The Question

- Can we construct an explicit microscopic realization of dS/CFT similar to the Klebanov-Polyakov correspondence?

## Motivation

$$\Lambda \sim N \quad \text{cosmological constant}$$
$$N \rightarrow -N$$

- Does the  $O(-N)$  model exist? If so, then

$$\Psi_{HH} = Z_{cft}$$

# Yes: the $Sp(N)$ CFT

Anninos, TH to appear

$$S_{cft} = \frac{1}{2} \int d^3x \Omega_{ab} \partial\chi^a \cdot \partial\chi^b$$

$\Omega \equiv$  antisym. symplectic form

## Evidence

- Spectrum of operators
- RG flow to an interacting critical point = Fourier transform of Hartle-Hawking
- 3-point correlators match Vasiliev theory

using: [Giombi and Yin](#)

# Conclusions

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- Main point: Higher spin gravity may provide a solveable *toy* model for quantum gravity in de Sitter.
- What can higher spin holography be used for? The original motivation -- so far not reached -- was to tackle thorny issues in holography, like:
  - ▶ Locality / RG flow
  - ▶ Tensionless string theory
  - ▶ Quantum cosmology